

## **EXHIBIT UU**

## TECH NOTES



1997, JEFFREY BROWN

# Redesigned Mach Z set to blister the lakes

New Ski-Doo twin aims to run faster, cleaner, quieter

**S**ki-Doo is No. 1 in snowmobile marketshare these days, and it got there with bold, high-tech moves. The REV blindsided the competition with its radical rider-forward position, and other makers are swallowing hard and running fast to catch up.

The 800 Rev is the most powerful

bump machine out there, though some may argue that the lighter 600 REV with its snappy SDI engine actually is quicker through big moguls.

When privateers on the tough snow-cross circuit flocked to the REV and started beating up on other brands' factory riders, there was no doubt about the REV's handling advantages.

So what do you do to top this success? You could make a larger monster bump grinder, or look beyond the bumps to even wider horizons.

Ski-Doo decided to widen the horizons, and the Canadian horizon that includes miles of lakes, rivers and smooth, well-groomed trails begs for a powerful "King of the

BY OLAV AAFEN

The Mach Z is a top end monster, but don't let its power fool you. This is an efficient machine that is environmentally friendly.

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The three-cylinder 800 Mach Z with triple pipes was the previous flagship on the big lakes, but new times demand that thirsty high-revving triples give way to cleaner, slower revving twins. The lower revs make more time available to get the right mix of fuel and air to meet EPA clean air regulations.

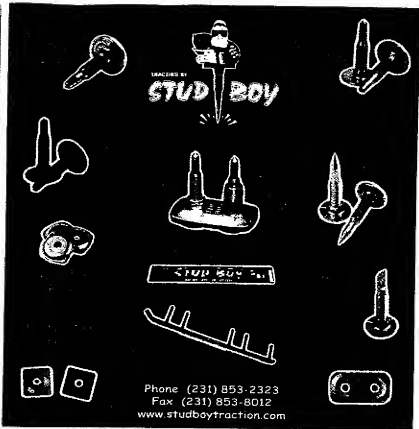
## A BOLDER LOOK

Ski Doo's new Mach Z combines the advantages of all of its new technologies into a new level of lake runner performance. The style is REA-inspired, but looks bolder, more aggressive with its lower ride height and longer chassis.

A two-inch longer engine bay was needed for the new 997cc twin, and this moved the skis further forward for better straight-line stability. Seating and handlebar positions have been moved back a couple of inches to get a slightly lower profile for fast trail touring. The rider is still centered something like eight inches further forward than with a conventional seat location. Lets face it, sitting on top of the tank works for bumps, but its not the place to be at a back twenty "plus" on your favorite "Bonneville" lake stretch.

With a power source pumping out 165 horsepower (15 more than the old Mach Z), top speed stability is important and that objective received high priority on this new sled. Should you hit an ice heave at high speed, the front arm of the new RT-100 rear suspension is calibrated through a new linkage system to absorb hard hits and stay straight, rather than throwing the sled side ways as with a stiffer rear bias.

Some people have wondered about the "shallow" one-inch track. Fact is, deep lug tracks come apart easier at the top end speeds we're



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## TECH NOTES



The mono-block cylinder design of the new Rotax twin cranks out 185 hp at 7,800 rpm and has 997cc worth of displacement.

talking about with this machine, and customers attracted to this sled would most likely prefer the stability of a serious number of studs to longer lugs. In reality, smooth hard pack is most likely the Mach Z's main environment.

### ROTAX 1000 IS BIG NEWS

Obviously, a great deal of thought went into the handling of this chassis. But the big news is the engine. Rotax has given the snowmobile world superb designs with innovations such as rotary valve intakes and rave exhaust valves that have been the standard to equal since the 1970s. Much of the credit for these designs goes to Hans Holtzleitner, the Rotax chief engineer, who can

add this new engine to his list of masterpieces.

Holtzleitner is highly regarded in international engineering circles and often is asked to attend SAE engineering panels at worldwide conferences where engineers and college professors present their research papers. I've learned through a source that at the conclusion of a presentation of emission research a number of years ago he expressed his disappointment in the lack of progress in innovative two-stroke emissions development. He felt that decade-old ideas were being beaten to death and new and more practical designs were needed.

Perhaps deciding to take the bull by the horns himself, a couple years



Twin pyramid reeds are cylinder mounted and directed upward to allow the engine to be tilted back 10 degrees. This move improves mass centering and gets the throttle bodies out of the way.

later Ski-Doo introduced the innovative semi-direct injection (SDI) now found on Rotax engines and aimed at meeting 2006 EPA goals.

### EMISSIONS DRIVE DESIGN

While the first SDI was applied to an existing 600 engine, the new Mach Z engine is the first Rotax snowmobile power plant designed from the ground up to meet new emission rules. A long 82-mm stroke is combined with an 88-mm bore, giving the big twin a total displacement of 997cc. Amazingly with its relatively long stroke, this engine still delivers its 165 hp at 7800 rpm that should put torque numbers in the 115 foot-pound range. The engine has traditional cylinder-mounted twin pyramid reeds directed upward to get the throttle bodies out of the way and allow the engine to be tilted back 10 degrees for improved mass centering.

The Mach Z features mono-block cylinder design where both cylinders are joined together in one casting. This is done to stiffen the engine assembly and to take some load off the crankcase, which otherwise would have to deal with more flexing under heavy crankshaft loads. To minimize vibration from the long stroke engine, two balancers are used - one on each end of the crank. The balancers are gear driven and sit in their own bearings, thus eliminating the extra weight of a balance

Since only air enters the case with the SDI design, you don't have the benefit of cooling from a regular fuel mix as it evaporates on the case's hot walls. To keep the walls colder, the case is heavily water-cooled. Large transfer passages occupy the cylinder walls and twin ring hard-anodized pistons run in nikasil-plated bores. The head features removable combustion chamber detents, and the cylinder cooling jackets are of the "bath tub" design. There are three exhaust ports, a large center port and two small auxiliary side ports controlled by power valves.

The outside power valves and the center port power valves operate independently from each other and the side valves open faster than the center valves. This is accomplished through a gear system powered by an electronically controlled step motor. The step motor is programmed by input from rpm and throttle position, and the valves aren't completely out of the way until 7300 rpm. This results in a smooth and controllable power band, which is as much at ease while it's hauling at top end on the lake as it is while cruising the trails.

The semi-direct injection works because of the placement of the fuel injectors in the rear transfer passages. This allows only unmixed fresh air through the front transfer passages and drastically reduces the number of unburned hydrocarbons escaping from the exhaust. The two injectors are different sizes - a smaller injector delivers fuel at idle and lower speeds, and a second larger injector kicks in at higher load. Fuel injection is sequentially timed to enter the air stream of the rear transfer passage at a single late enough to prevent any fuel from

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## TECH NOTES



Above: Mach Z has a beefed up clutch featuring all forged parts. Left: There's also a hefty silencer and plenty of sound dampening under the hood.

escaping from the exhaust port.

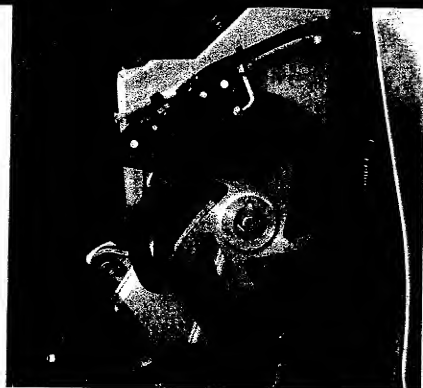
With a full engine management system in place, the power valve, ignition timing and fuel injection are controlled by feedback from rpm, throttle position, knock sensors, engine temperature, barometric pressure and even exhaust gas temperature. To make sure there's enough power available to keep the pump pressure up, a small dry-cell battery is complemented by a capacitor. Even with a dead battery, Ski-Doo claims it should only take a couple pulls to start it.

### POWER TRAIN BEEFS UP

The power train also has been beefed up to handle the extra power. Clutch parts are now forged, and the roller arms are made from steel. A Mitsubishi top cog belt transfers the power via variable angle sheaves.

Ski-Doo says it chose the Mitsubishi belt over the usual





The new "wave design" disc brake promises to stop this new sled in a hurry.

American brands because the Japanese company had shown a more aggressive attitude in developing a belt strong enough for the big twin power.

The chain is a stronger and more efficient HY-VO design with pivoting plates instead of pins and it won't stretch from use. So sure are Ski-Doo engineers about this that they've left out the chain tensioner. Stopping power comes via a large "wave design" disc mounted outside the chain case - this location makes it readily serviceable. The huge single expansion chamber exits into a large silencer and the intake is a generous 2-stage 20-liter design.

With ample amounts of sound-dampening foam placed strategically under the hood, this is a very quiet and pleasant sounding machine. We may take this for granted, but a twin of this size is probably one of the hardest combinations to effectively quiet down and must have taken a considerable effort from the engineering department.

With the lower stance and longer

chassis, this machine is a delight at normal trail speeds. If you try to go aggressively through the bumps it's obviously not quite as agile as a REV and naturally feels a little slower on the steering. But when you hit a nice long stretch, this machine shows its "lake runner" Mach Z heritage. It's fast, smooth, arrow straight and stable at top speed, with an added fun factor we didn't have with those older heavier triples.



Olav Aaen is a long-time contributor to the snowmobile industry. As a mechanical engineer and president of Aaen Performance,

Olav has been heavily involved with snowmobile performance since 1968. Aaen Performance is best known for pioneering performance pipes and introducing the roller clutch to the snowmobile marketplace.

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